

CLAIMS

1. A light distribution control element including a transparent base member, a number of micro-lenses densely arranged on one face of the transparent base member and a 5 light absorbing layer having very small opening portions substantially at focal positions of the micro-lenses, the light distribution control element characterized in that the transparent base member is constituted of a transparent body which is substantially isotropic optically or a 10 transparent body having uniaxial optical anisotropy.

2. A light distribution control element including a transparent base member, an adhering agent layer formed on one face of the transparent base member and a number of 15 very small spherical transparent beads embedded in and fixed to the adhering agent layer, the light distribution control element characterized in that the adhering agent layer is constituted of hot melt adhering agents obtained by laminating a transparent layer and a colored layer in 20 this order on the transparent base member and the transparent base member is constituted of a transparent body which is substantially isotropic optically or a transparent body having uniaxial optical anisotropy.

25 3. The light distribution control element according to Claim 1 or 2, wherein the transparent base member comprises a glass plate, a triacetylcellulose film, a non-

elongated polycarbonate film or an injection-molded acrylic resin.

4. A rear projection type display apparatus  
5 including a projecting apparatus for projecting an optical image and a transmission type screen, on a rear face of which projected light from the projecting apparatus is incident, for displaying the projected light at a front face thereof, the rear projection type display apparatus  
10 characterized in that:

the projecting apparatus comprises a single tube type projecting apparatus having a light source, two-dimensional optical switch elements for modulating light from the light source into an optical image in accordance with image information and a projecting lens for enlarging and projecting the optical image after the modulation, and further comprises: polarized light state aligning means for making polarized states of optical image lights formed by the two-dimensional optical switch elements substantially coincide with each other over the entire region of visible wavelengths when the optical image after the modulation emitted from the projecting apparatus is incident on the transmission type screen; and

the transmission type screen is constituted of a light distribution control element including a transparent base member, a number of micro-lenses densely arranged on one face of the transparent base member and a light

absorbing layer having very small opening portions substantially at focal positions of the micro-lenses, the transparent base member being constituted of a transparent body which is substantially isotropic optically or a 5 transparent body having uniaxial optical anisotropy, and light flux collimating means provided on a projected light incident side of the light distribution control element.

5. The rear projection type display apparatus  
10 according to Claim 4, wherein the transmission type screen is the light distribution control element comprising the transparent base member, adhering agent layers formed on one face of the transparent base member and a number of very small spherical transparent beads embedded in and  
15 fixed into the adhering agent layers, the adhering agent layers being constituted of hot melt adhering agents obtained by laminating a transparent layer and a colored layer in this order on the transparent base member and the transparent base member is constituted of a transparent body which is substantially isotropic optically or a  
20 transparent body having uniaxial optical anisotropy, and the light flux collimating means provided on the projected light incident side of the light distribution control element.

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6. The rear projection type display apparatus according to Claim 4 or 5, wherein the two-dimensional

optical switch element is a two-dimensional optical switch element for executing display by utilizing polarized light and the polarized light state aligning means is an optical element having a liquid crystal layer for satisfying a 5 condition of a waveguide arranged on a light emitting side of the two-dimensional optical switch element.

7. The rear projection type display apparatus according to Claim 4 or 5, wherein the two-dimensional 10 optical switch element is a two-dimensional optical switch element for executing display by utilizing polarized light and the polarized light state aligning means is a half wave plate or a laminated body of polymer films arranged on a light emitting side of the two-dimensional optical switch 15 element.

8. The rear projection type display apparatus according to Claim 4 or 5, wherein the two-dimensional 20 optical switch element is a two-dimensional optical switch element for executing display by utilizing polarized light and in the polarized light state aligning means, a transmission axis of linearly polarized light of an analyzer arranged on a light emitting side of the two-dimensional optical switch element is directed in a 25 vertical direction or a horizontal direction relative to a display face.

9. The rear projection type display apparatus according to Claim 4 or 5, wherein the two-dimensional optical switch element is a two-dimensional optical switch element for executing display by utilizing polarized light,  
5 the two-dimensional optical switch element comprising polarized light state converting means for converting a polarized light state of optical image light formed by the two-dimensional optical switch element into any of a polarized light state of linearly polarized light having an  
10 oscillation direction of an electric vector directed in a horizontal direction relative to a display face of the transmission type screen, linearly polarized light directed in a vertical direction, circularly polarized light and elliptically polarized light.

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10. The rear projection type display apparatus according to Claim 9, wherein the polarized light state converting means is constituted of a TN (Twisted Nematic) liquid crystal element or an ECB (Electrically Controlled  
20 Birefringence) liquid crystal element.

11. The rear projection type display apparatus according to Claim 9 or 10, further comprising an observer sensing unit for sensing the presence or absence of an  
25 observer, observer position determining means for determining positions of the observer in the horizontal and vertical directions by a sensed signal of the observer

sensing unit, and control signal outputting means for outputting a control signal to a polarized light state converting element based on information of the observer position determining means.

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12. The rear projection type display apparatus according to Claim 9 or 10, wherein the polarized light state converting means is constituted of a phase contrast plate or a polymer-laminated film.

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13. A rear projection type display apparatus including a projecting apparatus for projecting an optical image and a transmission type screen, on a rear face of which projected light from the projecting apparatus is incident, for displaying the projected light at a front face thereof, the rear projection type display apparatus characterized in that:

the projecting apparatus comprises a single tube type projecting apparatus having a light source, two-dimensional optical switch elements for modulating light from the light source into an optical image in accordance with image information and a projecting lens for enlarging and projecting the optical image after the modulation;

25 the transmission type screen comprises a light distribution control element having a transparent base member, a number of micro-lenses densely arranged on one face of the transparent base member and a light absorbing

layer having very small opening portions substantially at focal positions of the micro-lenses, and light flux collimating means arranged on a projected light incident side of the light distribution control element, and further 5 comprises: unpolarized light forming means for converting projected light emitted from the projecting apparatus and incident on the transmission type screen into substantially unpolarized light.

10 14. The rear projection type display apparatus according to Claim 13, wherein the transparent base member is a polyethylene terephthalate film.

15 15. The rear projection type display apparatus according to Claim 13 or 14, wherein the unpolarized light forming means is a pseudo-depolarizer for forming substantially unpolarized light in respect of a phase.

20 16. The rear projection type display apparatus according to Claim 13 or 14, wherein a two-dimensional optical switch element which does not need polarized light in display such as a polymer dispersion type liquid crystal element is used as the unpolarized light forming means.

25 17. A liquid crystal display apparatus including a pair of transparent substrates of a lamination of transparent electrodes and orientation films and being

bonded to each other with a constant clearance therebetween while orientation films formed faces opposed to each other, a liquid crystal layer enclosed in the clearance, voltage applying means for applying a voltage corresponding to an 5 image signal across the transparent electrodes and a polarizer and an analyzer disposed on a light incident face side and a light emitting face side of the pair of transparent substrates,

the liquid crystal display characterized in that a 10 rear face of each of the pair of transparent substrates is provided with a backlight apparatus for emitting substantially parallel light and the light emitting face side of the pair of transparent substrates is provided with a light distribution control element comprising a 15 transparent base member, a number of micro-lenses densely arranged on one face of the transparent base member and a light absorbing layer having very small opening portions substantially at focal positions of the micro-lenses, the light distribution control element being a light 20 distribution control element in which the transparent base member is constituted of a transparent body which is substantially isotropic optically or a transparent body having uniaxial optical anisotropy.

25 18. The liquid crystal display apparatus according to Claim 17, wherein the light emitting face side of each of the pair of transparent substrates is provided with a

light distribution control element comprising the transparent base member, adhering agent layers formed on one face of the transparent base member and a number of very small spherical transparent beads embedded in and 5 fixed to the adhering agent layers, the adhering agent layers being constituted of hot melt adhering agents obtained by laminating a transparent layer and a colored layer in this order on the transparent base member;

the transparent base member is constituted of the 10 transparent body which is substantially isotropic optically or the transparent body having the uniaxial optical anisotropy.

19. The liquid crystal display apparatus according 15 to Claim 17 or 18, wherein the light incident face side of each of the pair of transparent substrates is provided with a polarizer and the light emitting face side is provided with an analyzer and the light distribution control element with an analyzer and the light distribution control element in this order from a side of the transparent base member; 20 and

a transmission axis of linearly polarized light of the analyzer is arranged in a horizontal direction relative to a display face.

25 20. The liquid crystal display apparatus according to Claim 17 or 18, wherein the light incident face side of each of the pair of transparent substrates is provided with

a polarizer, the light emitting face side is provided with an analyzer and the light distribution control element in this order from a side of the transparent substrate, and a phase contrast plate is interposed between the analyzer and

5 the light distribution control element.